Framing urban development; spatial strategies by sister-cities Wuhan, China and Arnhem, Netherlands

Summary
This comparative study by the sister-cities Wuhan, China and Arnhem, Netherlands, describes the masterplan-strategies of both cities to manage urban development, avoiding urban sprawl, focusing on a balance between built up area and open space, between successful urban growth and livability, between urban and rural space.
Keywords are polycentricity, a strong green-blue framework and the 'greenport-concept' with 'metropolitan agriculture' as a new concept for urban-rural co-growth.
Park Lingezeegen in the Urban Region Arnhem-Nijmegen and a pilot program in the Greater East Lake area in Wuhan are examples of concrete initiatives to strengthen the green-blue framework with a key role for metropolitan agriculture.

1. Introduction

For already nine years there is a vibrant sister-relation between the cities of Wuhan in the middle of China and Arnhem in the middle of the Netherlands.
Started with missions in the field of economic, social and cultural affairs, in recent years urban and regional planning has become a major topic in the cooperation-program between both cities.
This was underlined by a Memorandum of Understanding, signed by the Wuhan Planning and Design Institute, the Department of Urban Development from the Municipality of Arnhem and Arcadis Company, a world wide consultancy, with the head office situated in Arnhem.

Seminars related to urban planning were organized in China and the Netherlands, focusing on topics of cultural heritage, the creative economy and riverfront development; Wuhan and Arnhem are river-cities situated respectively at the Yangtze River and the River Rijn. Both are capitals of respectively the province of Hubei and the province of Gelderland.

Wuhan belongs to the category of large cities in China, counting over 8 million people and developing in high speed.
The Wuhan municipality is a polycentric urban network with 4 million people living in de central city, and the rest of the inhabitants living in 6 centers of the second level and quite some smaller villages, dispersed over the area. The municipality covers a surface of 8.494 km2.
In the Chinese planning categories (1) of 'small', 'medium-sized' and 'large' cities (respectively: < 200.000, 200.000- 500.000, > 500.000), Arnhem is a small city belonging to a medium-sized Urban network 'Arnhem-Nijmegen' of 720.000 inhabitants, in aerial size 1000 km² . This is also to be considered as a polycentric urban network, consisting of twenty municipalities in which the cities of Arnhem and Nijmegen form the two main urban centers (together 300.000 inhabitants).
So, large differences in scale between both sister-cities but similarities in the polycentric urban pattern and also similarities in urban planning assignments due to high urban densities, urban pressure on open space in and around both cities. Related to this there are also similar planning issues focusing on urban transformation and renewal, water management, energy saving and transport networks.
If a city is to be regarded as a node of different activities, all organized in their own networks, the city's role is depending on her position in these different networks, being economic networks and or cultural networks, institutional networks, networks related to science, transport etc. There ìs a relation with 'size', but city's position and ranking in the different networks is decisive for its appearance and success. As was argued already on the 40th

ISOCARP conference on Management of Urban Regions (2), city's success is hardly a matter of size. The position in (inter-)national networks is decisive for success and vitality. Or, putting it in a different way, cooperation in networks creates 'size'.

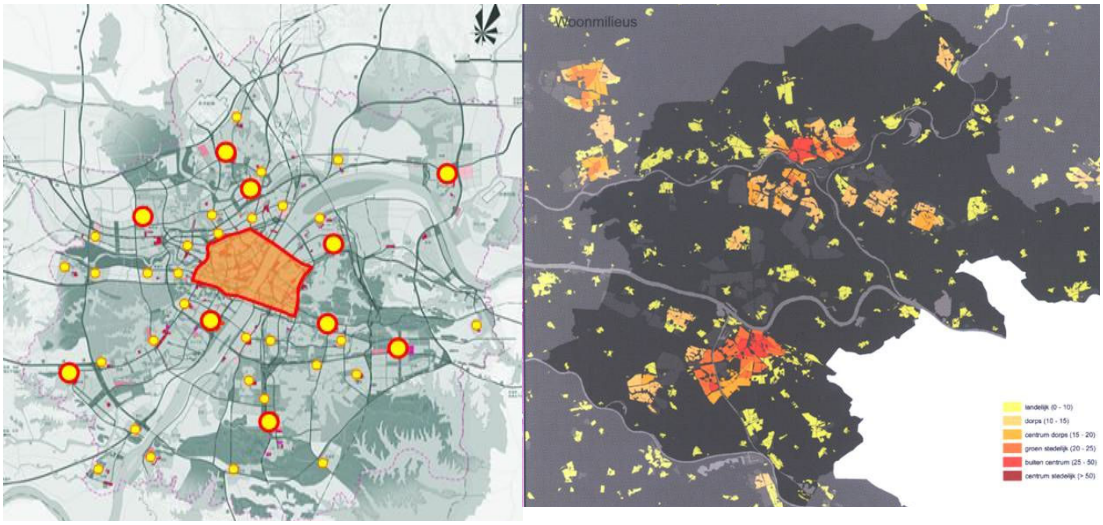

Fig.1. Two polycentric urban networks: City Wuhan and the Urban region Arnhem-Nijmegen

Examples are relatively small cities like Geneva, Frankfurt and Atlanta, having a solid position as specialized international centers (of the UN, European banking, transportation). If a city is an important node in such a network then it is to be seen as a 'hub'. A world-city is combining a hub status in several networks, having a 'multiple hub status'.
As argued before, medium sized cities can play a role as an important node in specific economic, cultural etc. networks. A relatively small city like Antwerp (43th ISOCARP congress 2007) has a global role as a hub in transportation (seaport) and in diamond trade.

Wuhan's role in China and Asia is growing fast. The national and international status as a hub in networks of economy and transport is reflected in rapid development of the transportation network. The track of the new high speed train now is under construction, forming an important north-south axis, connecting Wuhan with Guanzhou in the south of China and Beijing in the North.
The yearly growth of the amount of passengers on Wuhan airport is about 30 to 40 %. The expansion of the airport in a few years time will transform the airport from a regional and national transport hub into an international hub. The headlines of the new master-plan of the airport are just presented and already end of 2008 the large scale construction of 'terminal 3' for international flights will be started.
In relative terms for Arnhem and the Arnhem-Nijmegen Urban Network the connection in nearby future to the network of the European high speed train, connecting the city of Arnhem with the Amsterdam metropolis in the west and the German industrial core zone of the Ruhr Area in the east, has comparable potential as the connection of Wuhan to the high speed train axis Beijing – Guanzhou.

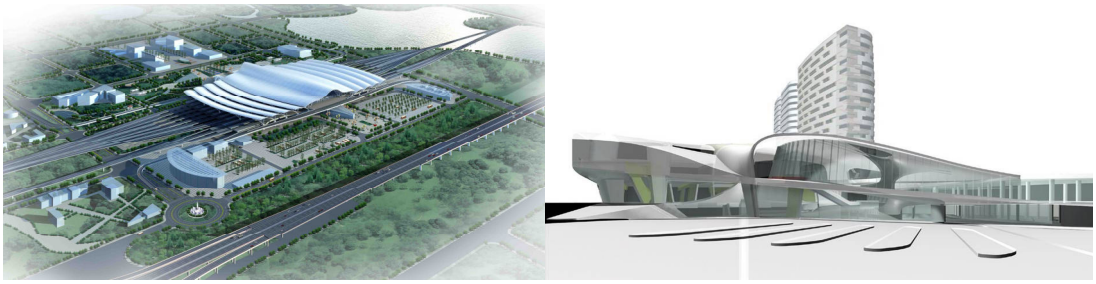

Fig. 2. New train stations facilitating new high speed train corridors: station Wuhan on the axis Beijing-Guanzhou (left); station Arnhem on the axis Amsterdam metropolis – industrial core zone Ruhr Area in Germany.

The introductory remarks underline the importance of city's position in networks; city's morphological size is not decisive. Looking to the urban space, this creates the argument and basis for combining success and livability: being a successful city as an important node (hub) in different networks but also being a livable city with open space, and good environmental conditions.
In fact, the combination of being a strong (multiple) hub in several networks ànd a livable city with high quality residential areas, with open ('green', 'blue') space in the urban morphology creates the real successful city, being the vital ànd sustainable city. This study describes the framework both cities, in quite different circumstances, apply, focusing on this balance between success and livability, between built up area and open space, between urban and rural space. Polycentricity is one of the key words in this framework.

2. Polycentricity

Polycentricity is a strong concept with opportunities to use city's assets (focusing on specific qualities and the position of the several city-nodes in all kinds of networks) and –in a morphological way- to get grip and control over urban development and urban sprawl.
A nice example is also the city of Istanbul; the new city's masterplan was presented at the ISOCARP-congress of 2006. Confronted with hardly to control urban growth and sprawl, Istanbul abandoned the concept of mono-centric development as a future compass and focuses on a polycentric model, giving the city more control over sprawl (3).
Recently the European Spatial Planning Observation Network, ESPON, did a thorough analysis on polycentricity (4).
Polycentricity and rural-urban relationships are among the key new ideas in the European Spatial Development Perspective, the ESPD, of 1999.
Polycentricity is generally seen as the opposite to dispersal and urban sprawl, often caused by ongoing monocentric development. Polycentricity is one of the central themes of the ESDP. Four dimensions of polycentricity can be distinguished:

- Morphological settlement patterns; the distribution of population, built up area, infrastructure over the several urban centers in a territory. In fact, the dimension that is to be seen as the main-focus of our paper.
- Functional socio-economic specialization; the specialization of the several centers based on the key competences they represent;
- Accessibility in terms of transportation and ICT; polycentric development is also about the connection between nodes in a polycentric pattern. In particular, the proximity to transport nodes and accessibility of information are crucial assets.
- Cooperation and interaction; the several urban nodes are embedded in specific networks in which cooperation, complementarity and synergy are key-words. Whereas 'accessibility' and 'specialization' target the potential of polycentric development, this aspect is about the use of such potentials.

As ESPON points out, polycentricity can be applied at three levels: the European (macro), the national and interregional (meso) and the intraregional (micro). The urban networks of Wuhan and the Arnhem-Nijmegen region are to be characterized as 'intraregional' in ESPON terms.
It will takes us too far to discuss the results of the study, but key statements are: there is a overarching goal of polycentricity in Europe, it appeals to goals of socio-economic balance over large territories and avoiding uncontrolled sprawl in monocentric patterns. The reality of dispersal of urban nodes in Europe shows a polycentric pattern but –on a European scale- there is a concentration of the strongest nodes in the so called 'Pentagon area' (5), a territory defined by the metropolises of London, Paris, Milan, Munich and Hamburg (6).

3. Polycentricity and green-blue framework

The ESPD focuses attention on new urban-rural partnerships. Several policy goals are involved in this. But one of the main goals is 'integrating the countryside surrounding large cities, in spatial development strategies for urban regions, aiming at more efficient landuse, paying special attention to the quality of life in the urban surroundings': green space as a quality in the urban pattern. On the other hand, there is the profit for agriculture in the proximity of urban nodes, giving special chances for niche markets (i.e. organic farming), agricultural diversification (i.e. tourism, leisure) or –on a larger scale- 'metropolitan agriculture' using the proximity of the urban area as a market for innovative demand-oriented food production and innovative energy-production.
However, in a poly-centered urban structure, urban pressure on the open in-between space can increase in a way, it leads to ongoing urban sprawl; then the open space and the polycentricity are at stake.
To ensure open space and polycentricity a strong green-blue framework is needed, separating the urban nodes and creating 'green and blue quality' in the in-between area (recreation, agriculture, waterstorage).
Both cities, Wuhan and Arnhem respectively the Urban region Arnhem Nijmegen, underline the importance of such green-blue frameworks.

3.1 Wuhan

The polycentric urban pattern is confirmed in the Wuhan Masterplan. It describes the outlines of a green and blue framework in which the urban nodes are located and separated.

The green area in the outskirts penetrate into the core zone of city's urban network, mitigating the effect of 'heat-islands', establishing ecological corridors and separating the urban nodes. Six open wedges between the urban nodes are designated. They represent inherent values of ecology, landscape, agriculture, water storage. To ensure protection of these open spaces and green-blue wedges, the masterplan has identified zones forbidden or restricted for use as urban construction land.

Fig. 3. Wuhan: six green wedges, framing the urban area, strengthening the 'polycentricity' of the urban pattern.

3.2 Arnhem and the Urban region Arnhem-Nijmegen

The urban area of Arnhem is modeled, 'framed', by a green and blue network of spaces and corridors. In a way it can be compared with the famous greenbelt in London which, as a mould, has modeled and buffered the growing urban space of the city.
In Arnhem it was and is the blue framework of the river, brooks and ditches with the green framework of the 'large green around the city', the 'large green in the city' and the ' green on district-level' . In the north this 'large green areas' are to be considered as green feeders from the large natural area in the north, the so-called Veluwe, penetrating the city, creating a 'red-green' differentiation in the urban area. Famous example is the so called Sonsbeek park, which as a green wedge from the natural area in the north touches the heart of the city. Thanks to the foresight of the municipal officials 100 years ago, who decided to buy a large green estate on this strategic location, using this only for a smaller part for urbanization and for a larger part as park and green buffer.

Fig.4. Park Sonsbeek Arnhem (right) and the River-park along the Yangtze River in Wuhan.

The green-blue contrasts as mentioned above, being essential for the spatial quality of the city, are marked in the Arnhem Masterplan (' structureplan'), the strategic spatial compass for the long run. The green qualities are seen as a major asset for the city as a whole. The masterplan defines these as part of the urban mainstructure; they have to be protected and developed. These masterplan guidelines are implemented and formalized on the smaller scale of zoning plans in the city. The masterplan was elaborated in a so-called Green-plan, not only detailing the spatial aspects of the green topics of the masterplan but also distinguishing the various aspects of 'green' - functional, ecological, cultural heritage- and what is needed for their protection and integration in new urban development plans. Also aspects of management and maintenance of green areas and corridors are prescribed.

A distinction is made between so-called ' structural green' and ' flexible green'. Structural green is to be protected in case of urban development, initiated either by the municipality or by the market. The arrangement on 'flexible green' is less strict: the condition is that the total areal size in a certain district of the city will not diminish.
If, under special conditions, urban development will have effects on size or quality of the 'structural green values' , these need to be compensated by the developer creating additional green area with a certain surplus.

More or less the comparison can be made with the distinction in the Wuhan Masterplan in 'forbidden zones for construction' and 'zones with limitations for construction', designated because of 'green values' (parks, natural area, basic farmland, general farmland).
The Arnhem Green-plan distinguishes three green-layers of different scale: 1. the ' large green around the city' (natural area and parks), 2. the 'large green inside the city' (mainly parks) and 3. the smaller green on district level (small district parks, green lines and zones, green verges in district's road-network).

4. Ensuring the green blue framework; active interventions and investments.
As mentioned before, to ensure open space and polycentricity a strong green-blue framework is needed. Urban pressure on parts of this framework can be so severe that the masterplan-policy has to be accompanied by active measures to ensure openness of these zones and protection of the green and blue values in the open zones; interventions and investments initiated by the local government.
Examples of such interventions will be discussed for the Urban Region Arnhem-Nijmegen and the municipally Wuhan.

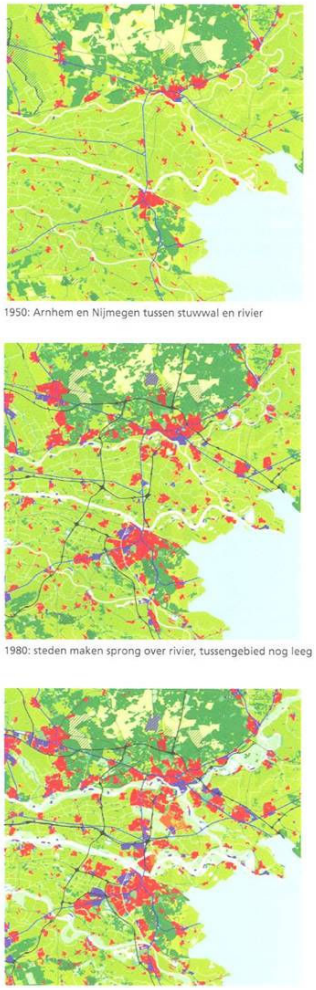

Fig. 5. Urban region Arnhem-Nijmegen; growing urban pressure on the in-between-area.

4.1 Urban Region Arnhem-Nijmegen, regional park Lingezeegen.
Currently a large project initiative is taken on the scale of the 'large green around the city': the creation of a regional park, more than 4 times the scale of Central Park New York: Park Lingezeegen (1500 hectares). The main objective is creating a strong green and blue buffer against ongoing urbanization in the middle area of the urban network Arnhem Nijmegen. Whereas the two main urban cores Arnhem and Nijmegen are expanding their urban field towards this central open area and also smaller villages, situated in the middle area, are expanding at high speed, there is an urgency of protecting the open green space. The present spatial structure of polycentricity of two cities and several smaller villages, surrounded by open space, is under pressure. There are zoning plans, controlling the land use in this middle-area, mainly farmland and dispersed built up area. But these are not able to stop the ongoing process of scattering or even turning it into a new coherent area.
Such a zone, under high urban pressure with scattered use of land, asks for a strong coherent concept, design and realization. A common initiative was taken by the province, the urban region and the municipalities involved to create a strong green and blue network on a regional scale that is:

- strong enough to resist and frame urban sprawl;
- on a regional scale creating rich differentiation between urban built up area and open space;
- a recreational area for the 160.000 inhabitants in the middle-area and the 720.000 inhabitants in the urban region;
- offering large capacity for additional water storage and –purification (wetlands, reed);
- managed as a growing model: a strong start by implementing the strategic parts of the green-blue framework that can be accomplished step by step;

- one coherent park with specific sub-areas (urban-recreational, water, combination agriculture and recreation, combination ecology and recreation, and also a part with built up facilities like a demonstration- and visitors-centre for innovative greenhouse horticulture.

Total costs are restricted to 100 million euro's due to an active strategy of land purchase by the government, focusing on the strategic parts: only 500 hectares (1/3 of the area) will be actively purchased, 300 hectares is and will remain agricultural land. Other parts of the park will be developed by market initiatives.
So, essential is a focus on mixed use: space for recreation, agriculture, nature, water, cultural heritage. There is no need for purchase of land covering the whole area and no need for total transformation of all the agricultural land-use into recreational use. Essential are recreational routes and connections, creating accessibility to the agricultural landscape for pedestrians, cyclists, horse riding, canoeing. The mixed land-use creates opportunities to integrate agriculture in the urban network, for agriculture using the proximity of urban areas:

- opportunities for diversification of agriculture, selling home made products, b&b, organic farming, offering congress-facilities on the farm etc.
- opportunities for metropolitan agriculture, intensifying in a sustainable way, demand-oriented, food -production and –processing using the urban logistics, energy production and deliverance to the urban area. Horticulture is integrated in this regional park; the glasshouses gave inspiration to the design of a ' crystal palace' in a special part of the park, being a demonstration center for innovative horticulture.

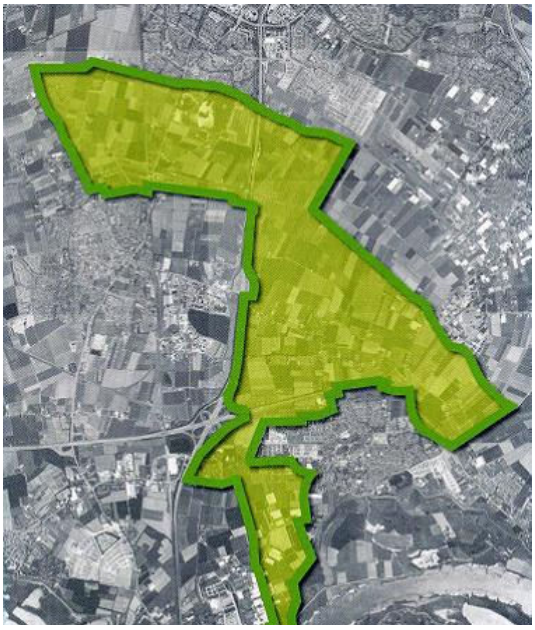

Fig.6. 'Framing' sprawl: design of a new regional park, being a green and blue frame-work against sprawl in the middle area between cities Arnhem and Nijmegen.

The concept of metropolitan agriculture is elaborated by Alterra Wageningen UR (University Research) in the Netherlands (7). A definition of 'metropolitan agriculture' that is agreed upon by the International Metropolitan Agriculture Organization, the World Food Farmers Organization and the UN Development Programme: metropolitan agriculture is the agriculture in and in the surrounding area of a city, covering a complete economic process involving production (or breeding), processing, transport and deliverance of farm products and services to the city. Being an integral part of urban economy and the urban system (flows of materials and energy), is the main difference with 'rural agriculture'. One can speak of mutual advantages, creating opportunities for a 'urban-rural co-growth'.

4.2 Wuhan, the greater Eastlake area.
The masterplan of Wuhan presents the headlines of the green and blue framework of Wuhan. The implementation of the concept of these green wedges under heavy urban and environmental pressure is a major challenge for the Wuhan municipality.
An example is the green wedge of Greater East Lake, one of the six green wedges of Wuhan, formed by Daoguanhe River area, Zhangduhu Lake wetland and East Lake area. It is open space with a number of large lakes and vast farmland, for a greater part designated as 'forbidden 'or 'restricted' area for construction in the municipal masterplan. This green wedge is surrounded by a large urban zone in the south, west and north.

The open area of greater East Lake faces serious challenges:

- environmental: existing pollution of the lakes due to emissions of agriculture (poultry, aqua farming) and domestic pollution coming from residential areas located in the middle-area (numerous small rural villages without sewerage); the current water quality of the lakes cannot meet the standards of swimming water;
- financial: the enormous costs of necessary measures to restore the water quality and to adapt the water system in a sustainable system: estimated costs around € 0.9 billion;
- agricultural: a scattered and small-scaled spatial structure sets constraints on land reconstruction and improvement of food production. New prospects are needed for the 62.000 villagers, involved in small-scaled farming on limited land;
- tourist: the use of the great tourist potential of the area with sufficient differentiation and synergy between the several parts is a major challenge. Although there is a start up in
- tourist development In Yandonghu Lake and Yanxihu Lake, it is rather similar to the East Lake area, thus creating competition in stead of synergy between these several parts;
- restrictions on urban development: the renewal of the area has to be realized within the severe constraints of the masterplan regarding urban construction.

Fig.7. Wuhan: six green wedges, framing the urban area, protecting the 'polycentricity' (left). Right: Eastlake area as one of the green wedges under urban pressure. Marked: the area for a possible 'greenport-pilot'.

The challenge is to implement a policy, ensuring the protection of open space, offering a firm basis for a prosperous and sustainable agriculture, facilitating the needs of the neighboring urban areas for recreation.
Considering the conditions and problems of the area this calls for an integrated strategy: it is not about just 'creating a park'. A new strategy is needed, creating new comprehensive solutions, dealing with the spatial and environmental issues, the necessary capital input and the functional aspects (agriculture, tourism).
The municipality of Wuhan is now elaborating this strategy, composed of the following elements:

1. Environment and ecology. Improvement of the environmental quality of the Greater East Lake Area, in particular: upgrading sluice capacity of the lakes and stopping the sludge in the lakes, connecting the water networks of lakes and river, creating a sustainable water system meeting the standards of ecology and recreation and a strict preservation of the

wetlands. This will be accompanied by measures of monitoring and control of pollution and disaster-prevention.
2. A 'two-type-society'. This refers to a new rural-urban life style using the diverse available resources of the area: arable land, the nearby logistic and industrial networks for agro food-processing and the recreational potential of the area for urban visitors. 'Concerted urban-rural co-growth' as a new perspective for the area.
3. Transforming settlements in one or more 'eco-cities', characterized by minimal ecological footprints (water quality, energy saving) and potential for eco-tourism.
4. Introduction and implementation of 'metropolitan agriculture' as means for accelerated concerted urban-rural co-growth.

The 'greenport-concept' is to be considered as a possible solution strategy for the area.
The greenport concept recognizes that the present spatial organization of agrosystems still is based on traditional land dependent forms. There are two dominant developments for agriculture in metropolitan areas:
- intensification, leading to agriculture without land;
- extensification, leading to pluri-activity and land without agriculture.

The driving forces to intensification and more land-independent forms of agriculture:
- lack of land due to ongoing urbanization
- necessary growth of food production
- veterinary problems (bird flue etc.)
- sustainable development (combining chains of different agro-productions, closed energy cycles).

The concept creates opportunities for new coalitions between the 'rural' and the 'urban': Urban ' waste' as input for agro-production and the deliverance of a energy surplus from agriculture / the 'rural' (for instance solar energy in greenhouse horticulture) to the 'urban'. But also the great opportunities for 'metropolitan agriculture' in using the urban infrastructure and logistics, in combination with the direct access to markets: every day there must be the guarantee of fresh food, to be delivered to the supermarkets in the whole metropolitan area. In the Netherlands there is a lot of experience with intensification of agriculture; large horticultural complexes and intensive livestock farming are sectors with a high degree of

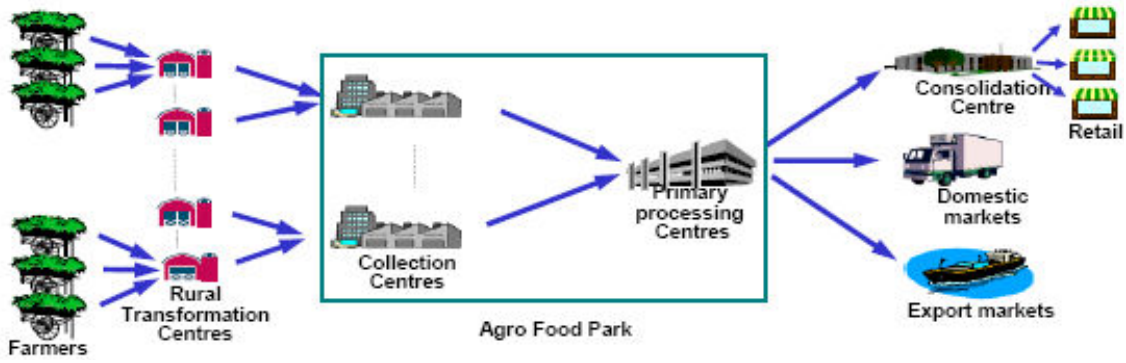

Fig.8. Network of agroparks: intelligent Eco- Network (Alterra Wageningen UR).

intensification. It is this experience that is applied in the Greenport concept in combination with new sustainable concepts (energy, lifecycle).

The Greenport concept offers opportunities for combinations with demonstration, education and leisure.
On a large scale the concept is implemented on Chongming Island, Shanghai (7), linked to a new 'eco-city'. The masterplan focuses on all kinds of exchange of materials, products and energy between the greenport and the ecocity, between the 'rural' and the 'urban'.

Currently Wuhan is planning to carry out a pilot program 'Greenport East Lake' in the greater East Lake area. A potential location of 10 km2 is taken into account, situated between Yanxihu Lake and Yandonghu Lake to test the Greenport-concept for the local conditions and demands. Most of the land in the area is used for agricultural purposes, mainly fish and rice. A village of 30.000 inhabitants is part of the pilot area. The Greenport-strategy focuses on renewal of the area, based on principles of metropolitan agriculture and eco-city with regard to the existing village in the area. In the present situation the village has a large ecological footprint in its environment.

So, in a spatial way, the Greenport-concept helps in implementing strategies against urban sprawl. The strategy is based on a new rural-urban coalition, linking the objective of controlling urban sprawl to objectives as food production, sustainability (energy, materials, products) and stopping the rural exodus.

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Notes of reference

1. PRC (People's Republic of China) Urban Planning Law, and 'Guideline for city planning'.

2. 40th ISOCARP-congress 2004, Management of Urban Regions. Session 3: Medium Sized Cities / Villes Moyennes, Rapporteur Maurits Schaafsma, Schiphol Real Estate BV, Netherlands.

3. 42th ISOCARP congress 2006, Istanbul: Cities between integration and disintegration; opportunities and challenges.

4. ESPON, European Spatial Planning Observation Network, 2006. Polycentric urban development and rural-urban partnership; thematic study of INTERREG and ESPON activities.

5. The concept of the 'pentagon area' (London, Paris, Milan, Munich, Hamburg) comes from the ESDP, the European Spatial Development Perspective.

6. ESPON developed the concept of the FUA: the Functional Urban Area, composed of an urban core (at least 15.000 inhabitants) and the surrounding commuter catchment area (at least 20.000 inhabitants). Scores on several indicators resulted in a category of the strongest nodes, so-called MEGA's, Metropolitan European Growth Areas. The others were characterized either as transnational/national FUAs or regional/local FUAs. The resulting maps show a concentration of the MEGAs with the highest ranking in the so-called 'Pentagon area', defined by the metropolises London, Paris, Milan, Munich and Hamburg. So, on a European scale there is polycentricity but, at this continental scale, there is a core zone, in which the most important nodes are concentrated and a periphery in which the less important nodes are more strongly represented.

7. Alterra Wageningen UR, Transforum, Shanghai Industrial Investment Corporation, 2007. Greenport Shanghai, better city, better agriculture, better life.

8. Municipalty of Wuhan, 2006. Masterplan Wuhan 2006-2020, comprehensive planning of Wuhan.